ENVIROMENTAL PRODUCT DECLARATION

In accordance with ISO 14025 and PCR 2018:01 v1.12. for:

ECOBRIDGE

EPD Program	The International EPD® System
Programme operator	EPD International AB
CPC Code	53221, Bridges and elevated highways
Based on	PCR 2018:01 v1.12. Bridges, elevated highways and tunnels. EPD System
Declaration number	S-P-04364
Publication date	2021-10-27
Valid until	2026-10-27
Market coverage	Worldwide
Representativeness	Spain

VIUDA DE SAINZ
Innovative tradition

VIUDA DE SAINZ is engaged in the execution, operation, maintenance and management of all kinds of civil works and construction contracts, both public and private, as well as associated services. The company's main area of activity is the province of Bizkaia, where it is the leading company in these types of activities. It has a total workforce of 200 and a pool of public works machinery consisting of more than 90 units. VIUDA DE SAINZ was set up as a Limited Liability Company in 1984, as a natural extension of the preexisting family firm dating from the 1960s. The Main Offices. Workshop and Warehouse of the company are located on the El Campillo industrial estate, within the municipality of Abanto y Ziérbena. It has 1600 m^2 of buildings and an open area of 2400 m^2.

VIUDA DE SAINZ has an Integrated Quality System. The Quality System has been designed to comply with all the requirements set out in the UNE-EN-ISO 9001:2000 standard allowing the company to guarantee the compliance of the projects it undertakes with quality requirements and to ensure complete customer satisfaction. Likewise, VIUDA DE SAINZ has been awarded the Occupational Health and Safety Management OHSAS 18001:2007 certificate, the Environmental Management ISO 14001 certificate, the EMAS certificate and the UNE-EN 166002 Innovation management standard. VIUDA DE SAINZ has carried out dozens of projects that have contributed to improving regional road systems. These include dual carriageways, roads and bridges, tunnels, viaducts and underground railway lines, favouring the transverse permeability of the region and the growth of the industrial and socio-economic fabric of the Autonomous Community of the Basque Country.

The Ecobridge

Bridges have traditionally been designed to accompany and outlive roads, their service life ranging a priori, according to the European standards, from 50 to 100 years, depending on the economic impact of the structure. The authors of projects for structures have to devise a durability strategy which makes sure that their designs resist the physical and chemical conditions to which they are exposed during that service life and which could even cause their degradation as a consequence of effects other than those stresses provided for in the structural analysis.

Al present, structures are rarely devised from an entire life cycle perspective; therefore, after those 50 or 100 years, the actions to be undertaken on them, their possible repairs or even their demolition have not usually been provided for. This is a problem we pass on to the coming generations.

This document sets out an innovative project which uses the principle of eco-design, understood as one of the levers to facilitate the transition to a more circular economy, in order to design a modular and removable bridge, which is not only characterized by the fact that it can be assembled and disassembled in record time with no need for qualified specialist teams, but also by the fact that it can subsequently be used in multiple locations, time and again, without any loss of performance.

These characteristics make this modular bridge the perfect solution for those situations in which a temporary crossing is required, either due to needs planned in advance or in situations of emergency, when it is necessary to replace the existing crossings and bridges due to poor performance or collapse, as a consequence of an extreme climate-related event, which unfortunately is becoming more and more common, even in our territory.

The design which is being presented, unlike other systems developed so far which do not provide such easy assembly and versatility, is light, low-cost, easy to assemble and use, even for non-specialist assembly teams, liable to be used in a wide range of spans, robust, safe, reliable, easy to maintain and able to resist all the loads defined in the standards of reference of the sector.

This EPD

This EPD describes the total environmental impact of a quick-install demountable bridge under the trade name Ecobrigde. The EPD was drafted in accordance with the PCR 2018:01 Bridges, elevated highways and tunnels v1.12 (published by International EPD System) and with EN 15804 for construction products.

The design of the Ecobridge includes significant amounts of steel and concrete. For the modelling of the end-of-life and recycling scenarios of these materials the current drafts of complementary PCR to EN15804 have been taken into account:

- FprEN 16757:2021 - Sustainability of construction works — Environmental product declarations — Product Category Rules for concrete and concrete elements.

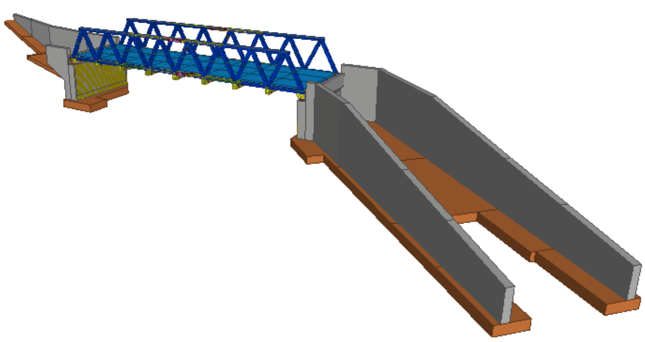
- prEN 17662:2021 - Execution of steel structures and aluminium structures - Environmental Product Declarations - Product category rules complementary to EN 15804 for Steel, Iron and Aluminium structural products for use in construction works.

The objective of this EPD is to provide experts and scientists in the construction sector with objective and reliable information based on life cycle assessment on the environmental impact of Ecobridge.

PRODUCT

Product description

The innovative nature of the project is also related to the methodology used in the design, manufacture and construction process. Three-dimensional digital models have been made of each of the structural parts of the ecobridge, using BIM (Building Information Modelling) methodology as a working tool. These models contain both technical and environmental information of the project. All results of the present EPD has been integrated into the digital mockups.The work process is briefly explained in the supplemnet information section.



Link to BIM model

The Ecobridge consists of the following main parts (3D model can be viewed by clicking on the link or scanning the QR code):

- A main structure, composed of two lateral metal trusses and a series of intermediate uprights that join them together.

- A secondary structure that forms the bridge deck, composed of self-supporting reinforced concrete slabs that are coupled between the metal uprights.

- Ramps and abutments.

The **main structure**, in a “U” shape, is composed of two planes of lateral trusses that are configured as Warren beams, using reinforced HEB-400 steel sections. Each of these trusses is separated into two parts, so that each of the pieces has dimensions of less than 17 m x 5 m, allowing it to be transported by road without the need for police escort. This is one of the keys to its ease of assembly, guaranteeing the principle of simplicity, which enables its successive use in multiple locations.

After being moved to the installation site, the two parts are joined together by means of a characteristic triple joint that allows rapid assembly. A tongue-and-groove joint is designed in the upper and lower upright to allow automatic positioning between the two parts, using a low-tonnage crane. Once the two parts are assembled, the joint is materialized with high elastic limit screws. On the diagonal, a butt joint is designed between the profiles of each part, also with high elastic limit bolts.

At the lower nodes of each truss, a rigid node is created, where a bolted joint allows the quick assembly of each of the 9 transverse uprights of the main supporting structure. The fasteners are installed by means of an industrial pneumatic screwdriver driven by compressed air from a compressor driven by electrical energy supplied by a diesel generator. It has not been possible to discern the fuel consumption of this device during

the assembly of the bridge. This generator also supplies electricity to the lighting system used during the installation of the Ecobridge

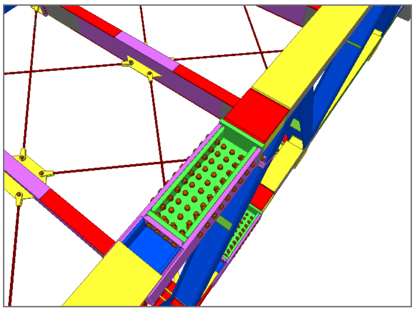
In this lower horizontal plane of the bridge, a double bracing system with 25 mm diameter bars is arranged in the form of St. Andrew's crosses.

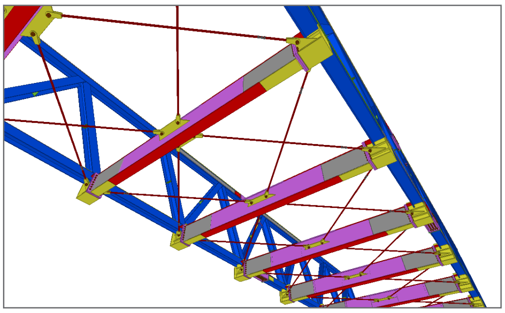
It should be noted that the design of the joints and their special configuration allow the bridge to be assembled and put in place in less than 1 day, when the usual construction time for this range of temporary structures is several months. The presented bridge complies with all the requirements and limit states imposed by the structural Eurocodes. Moreover, its design allows it to be assembled and disassembled by teams without specific qualifications, at low cost and in safe conditions for the operators. After disassembly, it can be moved and reused on another site without the need for any special reconditioning or remanufacturing operation.

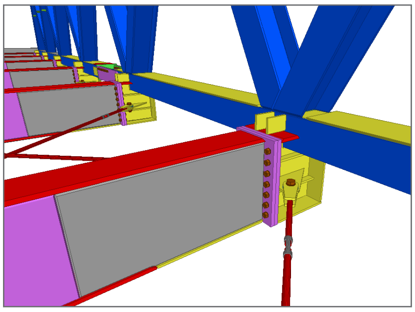
The span of the Ecobridge has been designed to accommodate traffic on a two-way road with two lanes in each direction along with a median and corresponding shoulders.

The **secondary structure**, which materializes the bridge deck, consists of 24 self-supporting reinforced concrete slabs, measuring 4.25 m x 2.70 m and with a depth of 0.30 m, each weighing less than 8 tons. These self-supporting slabs are lifted and placed between the transverse uprights of the main load-bearing structure, without requiring special lifting equipment. To facilitate their assembly and prevent their possible movement in the longitudinal direction, a 0.15 m x 0.05 m lower heel is included to limit this movement.

Traffic can circulate directly on the slabs in total safety conditions. Due to their design, it is not necessary to include any auxiliary element or additional compression layer to add weight and contribute to the overall strength of the structure. This fact is key to facilitate the dismantling of the secondary structure, since the slabs are simply supported on the main load-bearing structure, and in the same way that they rest on it, they can be hoisted again. It should be noted that, in the usual bridge designs and constructions, even in mixed bridges using prefabricated elements such as precast elements on metallic structures, the deck is made of a concrete layer executed in situ, which would in any case require demolition with heavy machinery and the generation of waste.







The slabs include two 50 mm diameter PVC through pipes, which allow the installation of a transverse tying system to ensure a monolithic operation of the deck also in that sense. This tying system consists of 28 mm diameter bars in each conduit, fastened at the ends with a plate and nut system.

The **ramps and abutments** are part of the Ecobridge insofar as they are necessary to lift traffic and divert it to different heights. Unlike the Ecobridge, other bridge solutions share the same level of the road on which they are located (for example, a bridge over a river, or a bridge to overcome a steep slope). Not being this the case, it has been considered that the Ecobridge itself, as a solution, has the abutments as a necessary part for the fulfillment of its function.

Dimensions (m)	
Bridge	
Span	35.25
Roadway width	7.00
Roadway width	8.1
Total width	9.4
Height	5.15 - 5.85
Embankments	
Length	32.7 and 36.7
Width	8.3

Applications

The Ecobridge represents a solution that allows assembly and disassembly in very short times and without the need for highly skilled teams. Its design allows reuse in other locations without loss of performance.

These characteristics make the Ecobridge ideal for situations where a temporary passage is required for a planned need. It can also be used in emergency situations where it is necessary to restore a pre-existing bridge due to loss of performance or collapse caused by an extreme event.

Technical data and composition

The characteristics of the Ecobridge as well as the breakdown of materials used are shown in the following tables.

Composition	Including embankments		Excluding embankments	
	kg	%	kg	%
Concrete	7,693,920	52.48%	259,488	66.61%
Gravel	6,497,820	44.32%	-	-
Reinforcing steel	306,247	2.09%	23,866	6.13%
Structural steel	99,097	0.68%	99,097	25.44%
Asphalt	61,200	0.42%	6,868	1.76%
PVC	850	0.006%	-	-
Bituminous	820	0.01%	-	-
Neoprene	797	0.01%	-	-
Paint	265	0.002%	265	0.07%

LCA INFORMATION

Declared unit

According to PCR 2018:01, the declared unit is one kilometre of bridge and year, with a reference service life of 100 years.

The Ecobrigde overpasses a span of 35.25m. The calculation of the service life has been estimated on the basis of the Structural Eurocodes and the Instruction on Actions to be Considered in the Design of Road Bridges (IAP-11), which sets a service life for road bridges of 100 years. In these 100 years, the use of the Ecobrigde is foreseen in 3 different locations.

PCR

This EPD follows the PCR 2018:01 v1.12. Bridges, elevated highways and tunnels in which the impact categories are quoted and published periodically on the International EPD System website.

PCR 2019:14 v1.11 (based on the Construction Products Standard 15804) has also been followed for:

- results reporting by the information modules A, B, C and D,
- reporting of additional indicators related to resource use, waste and other output flows,
- other methodological issues related to the use of secondary materials and end-of-life recycling.

Additionally, EoL scenario for structural steels has been determined on the basis of c-PCR to EN 15804 (prEN 17662:2021) and CO_2 absortion of concrete has been calculated according to c-PCR (FprEN 16757.2021).

System boundaries

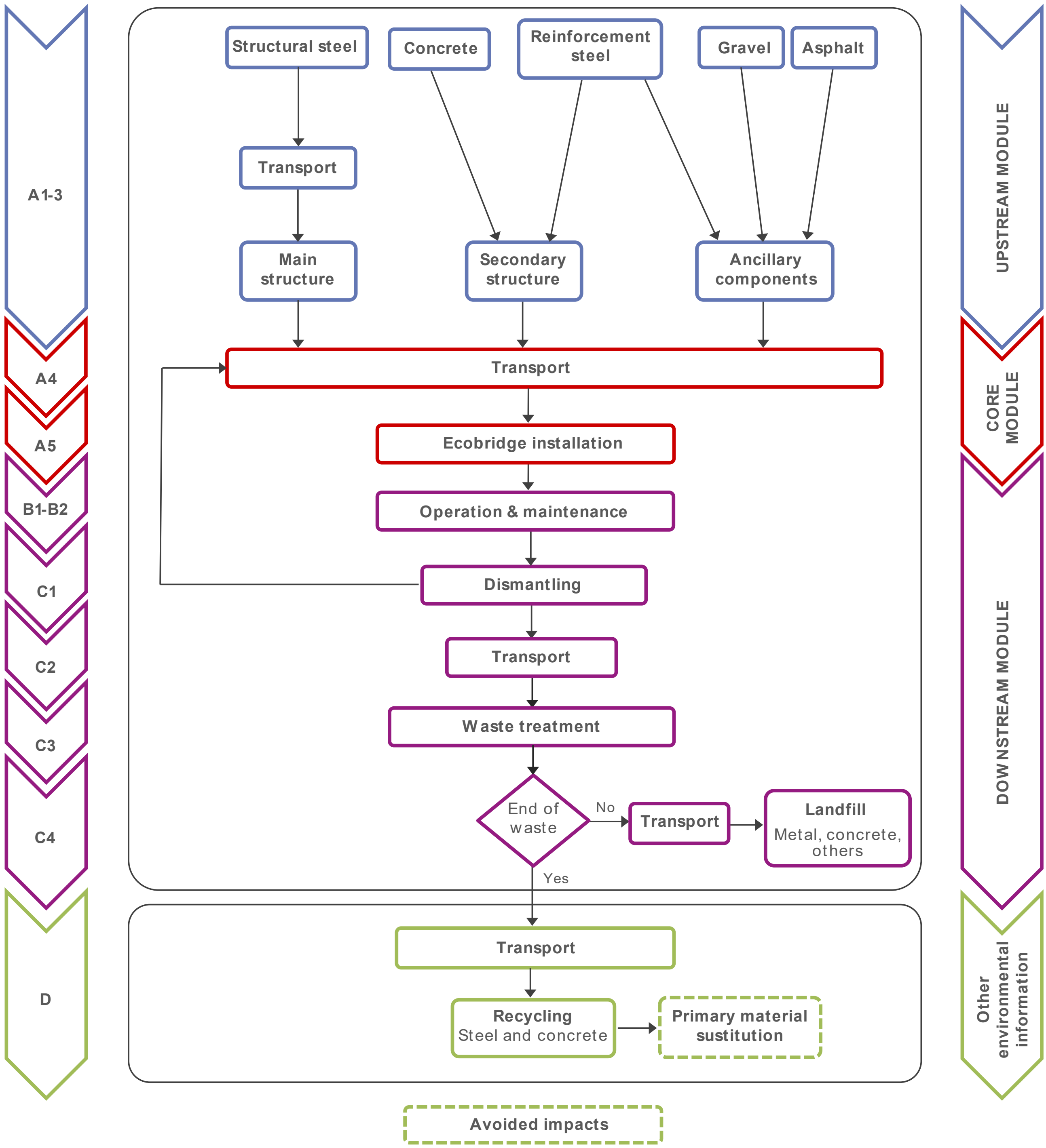
The following diagram shows the life cycle of the product reported in this EPD. This diagram shows all the stages of the life cycle, from the acquisition of raw materials for its manufacture to its recycling and disposal.

These stages have been classified according to PCR 2018:01 (upstream, core and downstream modules). They have also been classified according to the information modules specified by EN 15804.

Embankments are part of the Ecobridge as they are necessary for the fulfilment of its function, to raise traffic and divert it to a different height. In other situations, the bridge shares the same level as the road on which they are located. This not being the case, it has been considered that the Ecobridge itself, as a solution, has the embankments as a necessary part of the solution.

Upstream module considers all raw materials and processes required for the construction of the Ecobrigde and embankments. Core module includes the transport to the construction site, the installation of the Ecobridge and the construction of the embankments, all for three times in the 100 years of life. Downstream module includes the operation, maintenance and end of life of the Ecobrigde and embankments.

The potential environmental savings due to recycling at the end of life has been included (module D), being the result of the recycling process of steel and concrete and the avoided impacts from the substitution of primary raw materials (steel and gravel).



Stage	Production					Use							End-of-life				Resource recovery
Module	Raw materials supply	Transport	Manufacturing	Transport	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction	Transport	Waste processing	Disposal	Reuse, recovery or recycling potentials
	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Declared module	X	X	X	X	X	X	X	ND	ND	ND	ND	ND	X	X	X	X	X

ND - Not declared

CO_2 sequestration due to concrete carbonatation during the use and EoL phases has been included following the methodology described in FprEN 16757.

Database(s) and LCA software used

All LCI datasets were sourced from Ecoinvent v3.7. Structural steel was modeled adapting Ecoinvent v3.7 databases on the basis of the IRIS 2013 Report on steel recycling in the Spanish steel industry by UNESID (Unión de Empresas Siderúrgicas), which states that the Spanish steel sector is one of the largest recyclers in Europe, with 75% of the steel manufactured in Spain being recycled steel. For primary steel, the converter production database has been used while the electric arc steel production database was used for secondary steel.

The LCA study was performed using an excel-based model. The impact assessment results were calculated using characterization factors obtained from Simapro software.

Data Quality

The model is based on primary data provided by Viuda de Sainz (see BIM Integration in Supplement Information). A data quality analysis has been performed according to the scheme included in Annex E of the standard 15804:2012+A2 (UN Environment Global Guidance on LCA database development). It is found that the overall geographical, temporal and technological representativity can be described as good. For example, for the climate change category more than 52% of the impact comes from data with very good representativity while more than 41% of the impact comes from data with good representativity.

Estimates and Assumptions

Disposal and recovery rates for steels used in the Ecobridge are modelled based on prEN 17662 draft standard. For structural steel (trusses of Ecobridge main structure), the draft standard establishes that 11% can be reused and the remaining 89% can be recycled. However, it has been interpreted that the possibility of such reuse can occur in elements such as beams or columns that, once dismantled, retain sufficient length to be reused in another system. In this case, most of the components of the main structure are welded together and once cut during dismantling, the length of the profiles would not exceed 4 meters, which makes their reuse difficult. Therefore It was assumed a 100% for recovery rate for final recycling of Ecobridge main structure. The same standard states that reinforcing steel used in concrete has a default recovery rate of 90% while the remaining 10% goes to landfill. This standard also provides environmental aspects of the dismantling stage of metal structures such as the use of electricity, propane, diesel and oxygen. These environmental aspects have been used to characterise module C1 of the main structure of Ecobridge.

For the end of life of concrete, we have used the statistical analysis of Construction and Demolition Waste of the Basque Country carried out by the Department of Economic Development, Sustainability and Environment of the Basque Government in 2018. It concludes that 76% of construction and demolition waste is recycled. This value has been used to determine the amount of recycled aggregate that can be obtained from the concrete present in slabs, parapets, embankments and ramps.

For steel used in the Ecobridge (including reinforcing steel in concrete), module D reports only the loads and environmental benefits of the net outflow of post-consumer scrap. This net flow is calculated by subtracting the secondary steel content that was considered at system input from the amount recovered at end-of-life.

The secondary steel database (obtained by electric arc) has been used to model the conditioning operations of this net flow of post-consumer scrap to the same functional equivalence of a primary steel. The primary steel database (obtained by converter) was used to model the impacts avoided by the substitution of primary steel.

In the case of concrete, its treatment in the CDW management plant is reported in module C3. From these operations, reinforcing steel and concrete aggregates are obtained that can be used as filler material or recycled gravel in the formulation of new concrete. In this case, module D reports the impacts avoided by the substitution of primary or virgin aggregate. In this study, a correction factor based on an economic criterion has been used to denote the loss of quality of a recycled aggregate compared to virgin aggregate.

The filling material used in ramps comes from the execution of the road project that motivates the traffic diversion solved by the Ecobridge itself. In other situation this material would go to landfill. For this reason, it has been considered that it enters the system under study without environmental load. The transport of this filling material from the place where it originates to the location of the Ecobridge has been included in the analysis.

For the maintenance of the Ecobridge, the cleaning and repainting of the surface of the main structure has been considered each time it is assembled in a new location.

CO_2 sequestration due to concrete carbonatation during the use and EoL phases (B and C stages) has been included following the methodology described in FprEN 16757. The standard establishes standard and simplified methods for the calculation of CO_2 absorption in modules B and C. In the case of module B, the standard method has been chosen as the type of cement, cement concentration, time and exposure conditions are known. For module C, the simplified method was chosen because key parameters such as the particle size after crushing of the concrete and the average exposure time before reuse as recycled aggregate are not known.

Cutt-off rules

All available data from the production process are considered, raw materials used and utilised auxiliary materials. Elements such as the metal barrier, safety parapets, bracing bars and hardware are included. Welding, cleaning and painting of all metal surfaces of the Ecobridge are also included. The energy consumption during the installation of the Ecobridge (earthworks and cranes) is also included in the study

It has not been possible to estimate the energy consumption of operations such as site lighting, bolting of the structure or the removal of asphalt when Ecobridge is retired. These operations are carried out using electrical or mechanical energy provides by diesel combustion generators. However, it has been considered as not very relevant in comparison with the other processes involved. The maintenance of the construction machinery has not been included either, since all the operations carried out during the installation of the Ecobridge are executed in a period of time not exceeding one week in the case of the ramps and embankments, and 1 day in the case of the assembly and hoisting of the Ecobridge.

RESULTS

	INDICATOR	UNIT	Upstream module	Core module		Downstream module						Other environmental information
			A1-3	A4	A5	B1	B2	C1	C2	C3	C4	D
ENVIRONMENTAL IMPACTS	CC - total	kg CO_2 eq	1.52E+05	1.94E+04	495	-394	286	3.40E+03	1.39E+04	9.25E+02	1.64E+03	-4.90E+04
	CC - fossil	kg CO_2 eq	1.52E+05	1.94E+04	497	0	285	3.40E+03	1.39E+04	2.39E+03	1.64E+03	-4.90E+04
	CC - biogenic	kg CO_2 eq	788	10.4	0	0	0.643	1.32	9.43	6.10E+01	3.25	61.6
	CC - land	kg CO_2 eq	88	6.77	0	0	2.62E-02	0.301	4.51	4.76E+00	0.46	-15.7
	OD	kg CFC-11 eq	8.76E-03	3.56E-03	8.42E-05	0	2.03E-05	5.86E-04	2.68E-03	2.93E-04	5.48E-04	-2.42E-03
	A	kg SO_2 eq	552	50.3	3.873	0	3.39	32.6	36.9	13.6	14.1	-237
	E	kg PO_4^{-3} eq	224	10.6	0.724	0	0.562	5.95	7.73	7.93	2.62	-145
	POCP	kg NMVOC eq	604	52.3	5.512	0	0.959	47.1	40.1	9.69	17.5	-270
	AD-non fossil	kg Sb eq	7.54	0.525	8.30E-04	0	4.38E-03	5.36E-03	0.302	1.66E-02	1.53E-02	-1.39
	AD-fossil	MJ	1.25E+06	2.90E+05	6.79E+03	0	2.71E+03	4.69E+04	2.19E+05	2.83E+04	4.64E+04	-4.79E+05
	WU	m^3 eq	5.52E+04	846	11.71	0	1.75E+02	88.3	702	505	2.15E+03	-1.25E+04
RESOURCE USE	PERE	MJ	9.38E+04	4.18E+03	48.6	0	1.10E+03	311	2.94E+03	8.27E+03	379	-3.92E+04
	PERM	MJ	0	0	0	0	0	0	0	0	0	0
	PERT	MJ	9.39E+04	4.18E+03	48.6	0	1.23E+03	311	2.94E+03	8.27E+03	379	-3.92E+04
	PENRE	MJ	1.45E+06	3.14E+05	7.28E+03	0	3.38E+03	5.03E+04	2.37E+05	5.08E+04	4.98E+04	-5.08E+05
	PENRM	MJ	0	0	0	0	0	0	0	0	0	0
	PENRT	MJ	1.45E+06	3.14E+05	7.28E+03	0	3.38E+03	5.03E+04	2.37E+05	5.08E+04	4.98E+04	-5.08E+05
	SM	kg	0	0	0	0	0	0	0	0	0	0
	RSF	MJ	0	0	0	0	0	0	0	0	0	0
	NRSF	MJ	0	0	0	0	0	0	0	0	0	0
	FW	m^3 eq	4.75E+05	1.67E+04	249.5	0	636	1.52E+03	1.23E+04	2.50E+04	1.69E+03	-3.88E+05

RESULTS

	INCIDATOR	UNIT	Upstream module	Core module		Downstream module						Other environmental information
			A1-3	A4	A5	B1	B2	C1	C2	C3	C4	D
WASTE	HWD	kg	0	0	0	0	0	0	0	0	0	0
	NHWD	kg	0	0	0	0	0	0	0	0	0	0
	RWD	kg	0	0	0	0	0	0	0	0	0	0
OUTPUT FLOWS	CRU	kg	0	0	0	0	0	0	0	0	0	0
	MFR	kg	455	0	0	0	0	0	0	0	0	0
	MER	kg	0	0	0	0	0	0	0	0	0	0
	EE-e	MJ	0	0	0	0	0	0	0	0	0	0
	EE-t	MJ	0	0	0	0	0	0	0	0	0	0

ENVIRONMENTAL IMPACTS. CC: Climatic Change; OD: Ozone depletion; A: Acidification ; E: Eutrophication; POCF: Photochemical ozone creation potential; AD-non fossil: Abiotic resource depletion - minerals and metals; AD-fossil: Abiotic resource depletion - fossils; WU: Water use.

RESOURCE USE. PERE: Renewable primary energy as energy carrier; **PERM**: Renewable primary energy resource as material utilization; **PERT**: Total use of renewable primary energy resources; **PENRE**: Non-renewable primary energy as energy carrier; **PENRM**: Non-renewable primary energy as material utilization; **PENRT**: Total use of non-renewable primary energy resources; **SM**: Use of secondary materials; **RSF**: Use of renewable secondary fuels; **NRSF**: Use of non-renewable secondary fuels; **FW**: Use of net fresh water.

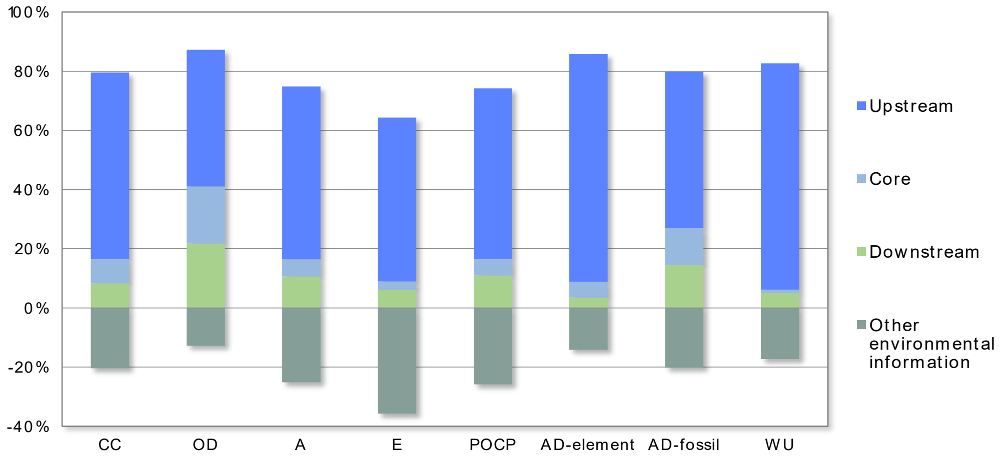
WASTE. HWD: Hazardous waste disposed; **NHWD**: Non-hazardous waste disposed; **RWD**: Radioactive waste disposed.

OUTPUT FLOWS. CRU: Components for re-use; **MFR**: Materials for recycling; **MER**: Materials for energy recovery; **EE-e**: Exported energy - electricity; **EE-t**: Exported energy - thermal.

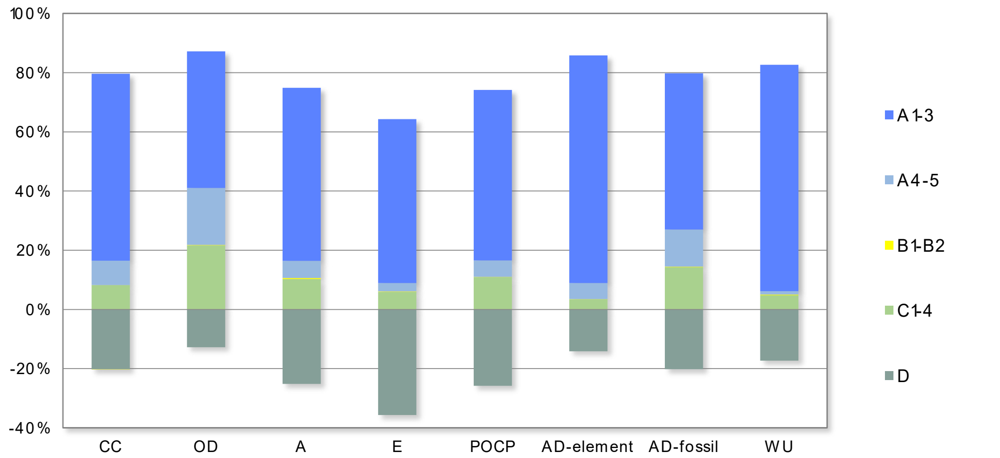
SUPPLEMENT INFORMATION

The following two figures show the contribution to the total impact broken down by the information modules of PCR 2018:01 v1.12 and those of the standard EN 15804.

MODULES FROM PCR 2018:01 v1.12



MODULES FROM EN 15804



All raw materials and auxiliary materials used in Ecobridge life cycle do not contain any substance included in the list of Substances of Very High Concern or substances on the REACH candidate list.

During construction, noise, water and air quality control regulations were respected. The site-specific environmental monitoring was carried out using a system of environmental sensors capable of measuring parameters related to water and air quality and noise emissions.

Water quality monitoring focused on temperature, pH, dissolved oxygen, redox (or oxidation-reduction chemical reactions), conductivity and turbidity. Air quality monitoring involved measuring suspended particulates, temperature, pressure and humidity. For noise monitoring, a sound level meter was used to evaluate the ambient noise level. In this way, noise maps could be made to comply with the requirements of Directive 2020/49/EC, as well as Law 13/2003 on Noise.

The reports from these environmental sensors were linked to a common data environment and their registration allowed compliance with the environmental quality levels established in the specifications.

BIM Integration

BIM methodology represents a paradigm shift in the conception and gestation of projects in the construction sector. This methodology has been used in the present EPD as an innovative tool to integrate digital mockups in the LCA calculations of a constructive solution. The aim has been to use and enhance BIM models generated during the design, manufacture and construction of the ecobridge as a centralised, accurate and digital source of information for the generation of the present EPD.

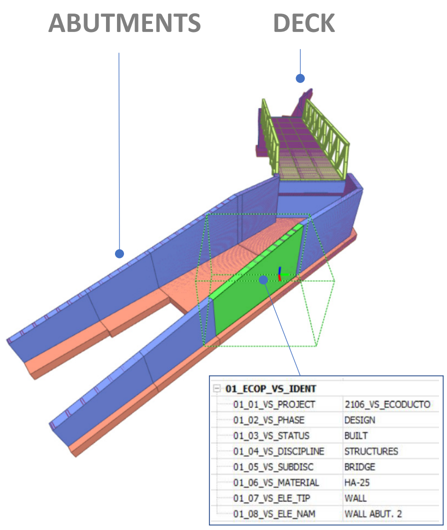
Digitalization and sustainability are both integrated into this EPD as a way for a more transparent, accurate and committed management of the data produced in the construction sector throughout its life cycle.

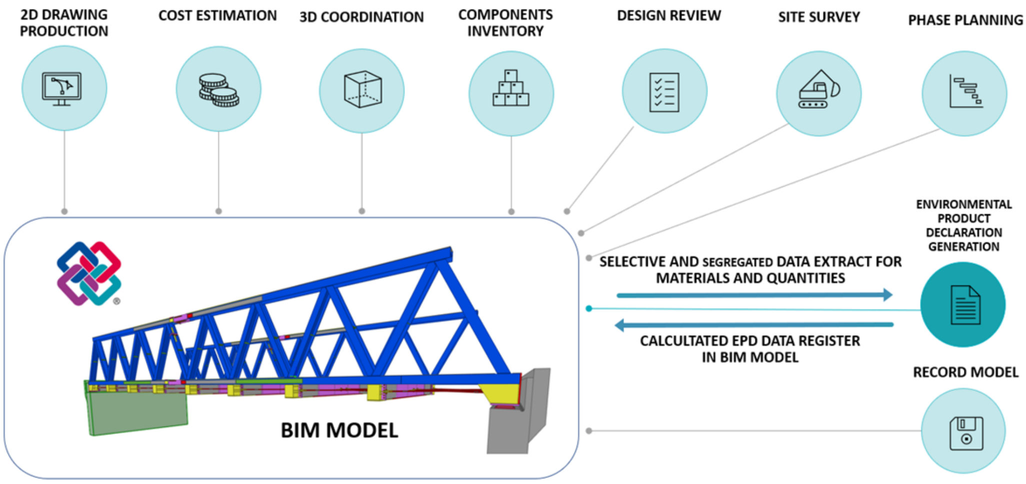
In the process of obtaining the input data for the environmental calculations, information extracted from the BIM models of the ecoduct (design, manufacture and construction) has been used as initial data (digital bill of quantities). In this way, the integral life cycle concept of BIM methodology has been integrated with the stages of the LCA methodology by extracting from BIM models (digital information models) the categorised, ordered and useful data that will be used for the different life cycle phases included in the present EPD.

For this purpose, fabrication BIM models have been used as a source of accurate measurement data for all the bridge elements integrated within the scope of this EPD. These model elements have been generated at the LOD400 level of geometric detail according to the BIM Forum's international level of detail classification (https://bimforum.org/LOD).

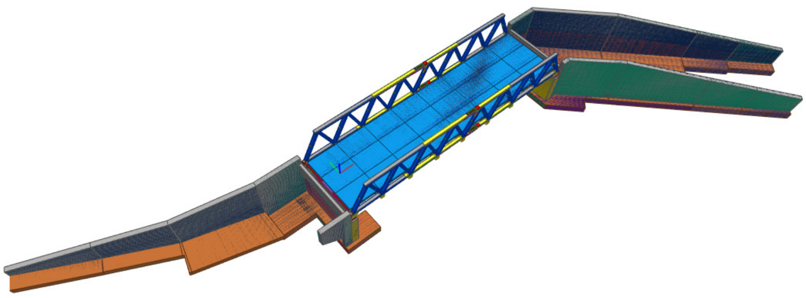
On this geometric model, the elements have been grouped and sorted, characterising them parametrically by groups and properties, which is a key process in the BIM methodology that allows the management of BIM models as ordered databases of information. The openwork format ".ifc" has been used to visualize the 3D mockup. This format, "Open BIM", allows aopen exchange standard promoted by Building Smart (https://www.buildingsmart.org/).

In order to further develop the use of BIM models as an integral information tool, the main emission values of the different indicators analyzed in the EPD have been incorporated as part of the parametric information contained in the 3D model. BIM model collects the environmental impacts calculated in this EPD, generating a library of environmental information based on 3D models.





This EPD represents, in conclusion, a new approach to digitalization through BIM models of the environmental parameters associated with Life Cycle Analysis, creating a precedent for their progressive incorporation in the early design phases. In this way, decision-making tools are generated for the detection of environmental impacts, analysis of more sustainable alternatives and transparency in the incorporation of environmental information that allow progress towards a more digital and sustainable construction.



01_GENERIC	
DAP Name	ECOBRIDGE
EPD AUTHOR	IDNÓVAM
EPD CO-AUTHOR& BIM INTEGRATION	INGREEN INNOVACIÓN
EPD OWNER	Viuda de Sainz S.A.
THIRD-PARTY VERIFIER	Centro Tecnológico de Miranda de Ebro
02_ENVIRONMENTAL IMPACTS	
A	4,88E+03 kg SO2 eq
AD- fossil	1,48E+07 MJ
AD-non fossil	7,35E+01 kg Sb eq
CC	1,47E+06 kg CO2 eq
E	1,21E+03 kg PO4 eq
OD	1,48E-01 kg CFC-11 eq
POCP	5,29E+03 kg NMVOC
WU	4,92E+05 m3 eq
03_RESOURCE USE	
FW	1,51E+06 m3
NRSF	0 MJ
PENRE	1,73E+07 MJ
PENRM	0 MJ
PENRT	1,73E+07 MJ
PERE	7,41E+05 MJ
PERM	0 MJ
PERT	7,42E+05 MJ
RSF	0 MJ
SM	0 Kg
04_WASTE	
HWD	3,53E+01 Kg
NHWD	4,05E+05 Kg
RWD	8,88E+01 Kg
05_OUTPUT FLOWS	
CRU	0 Kg
EE-e	0 MJ
EE-t	0 MJ
MER	0 Kg
MFR	4,76E+03 Kg

The investigation of the state of the art in the world of modular bridges shows that none of the solutions available on the market have been approached from an environmental perspective. approached from an environmental perspective.

The environmental improvement strategies applied in the design process of the eco-bridge have been impact reduction, design oriented to the recovery of materials, design oriented to promote a second useful life and optimization in the use phase.

Through the above strategies, a reduced weight design is obtained, oriented to the reuse and standardization of parts, simple and easy to use. standardization of parts, easy to recondition for reconditioning for reuse and that optimizes the use of raw optimizes the use of raw materials.

This design presents significant environmental improvements compared to more traditional solutions in the world of bridges: It prevents the generation of 270 tn of waste at the end of its life cycle and the GHG emissions are reduced by 45% compared to conventional solutions used for the same purpose.

VERIFICATION

This declaration is an environmental product declaration (EPD) in accordance with ISO 14025 and the requirements given in the product category rules document for Bridges, Elevated Highways and Tunnels, and Construction Products and Construction Services (EN 15804) and the general program guidelines by The International EPD® System. The results shown in this EPD are based on the LCA for Ecobridge designed by Viuda de Sainz according to standard 14044.

This EPD is not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages or are based on different Product Category Rules. EPDs may not be comparable if they do not comply with same PCR. In the same way, EPDs within the same product category but from different programmes may not be comparable.Viuda de Sainz is responsible for its content, as well as to preserve supporting documentation during the period of validity that justifies the data and statements that are included.

EPD Programme	The International EPD® System EPD International AB Box 210 60 SE-100 31 Stockholm Sweden www.environdec.com info@environdec.com
EPD registration number	S-P-04364
EPD owner	Viuda de Sainz, S.A.
Declared unit	Ecobridge
System boundaries	Cradle to gate with options
Published	2021 - 10 - 27
Valid until	2026 - 10 - 27
Reference year for data	2020
Geographical scope	Wordwide
Product group classification	UN CPC Code: 53221 Bridges and elevated highways
Product Category Rules	PCR 2018:01 v1.12. Bridges, elevated highways and tunnels. EPD System. Product Category Rules 2019:14 v1.0. Construction products. EPD System Based on CEN standard 15804:2012+A2:2019
PCR review was conducted by	Technical Committee of The International EPD® System www.environdec.com info@environdec.com
Independent verification of the declaration and data, according to ISO 14025:2006	☒ External ☐ Internal ☐
Third-party verifier	Lorena Pereda Centro Tecnológico de Miranda de Ebro www. ctme.es lpereda@ctme.es
EPD prepared by	IDNÓVAM Innovación y desarrollo para el ambiente info@idnovam.com

REFERENCES

- General Programme Instructions of The International EPD® System. Version 3.01, 2019-09-18.
- Product Category Rules 2018:01 v1.12. Bridges, elevated highways and tunnels product category classification: UN CPC 53221, 53222. Valid until: 2022-01-29
- Product Category Rules 2019:14 v1.0. Construction products. EPD System. Date 2019-12-20. Valid until 2024-12-20.
- EN 15804:2012+A2:2019, Sustainability of construction works - Environmental Product Declarations - Core rules for the product category of construction products
- FprEN 16757:2021, Sustainability of construction works — Environmental product declarations — Product Category Rules for concrete and concrete elements. 2021-02-05.
- prEN 17662, Execution of steel structures and aluminium structures - Environmental Product Declarations - Product category rules complementary to EN 15804 for Steel, Iron and Aluminium structural products for use in construction works. May 2021
- ISO 14025/ DIN EN ISO 14025:2009-11: Environmental labels and declarations - Type III environmental
- ISO 14040-44/ DIN EN ISO 14040:2006-10, Environmental management - Life cycle assessment-Principles
- Ecoinvent Database. http://www.ecoinvent.org/database/.
- IAP-11 - Instrucciones sobre las acciones a considerer en el proyecto de puentes de carretera. Centro de publicaciones. Secretaría General Técnica. Ministerio de Fomento. Gobierno de España. 2012. https://www.mitma.gob.es/recursos_mfom/0820303.pdf
- Estadística de Residuos de Construcción y Demolición de la C.A. del País Vasco. 2018. - www.Euskadi.eus.
- Informe 2013 sobre el reciclaje del acero en la Industria siderúrgica española. UNESID.

CONTACTS

EPD PROGRAMME

The International EPD® System
EPD International AB
Box 210 60
SE-100 31 Stockholm
Sweden
www.environdec.com

THIRD-PARTY VERIFIER

Lorena Pereda
Centro Tecnológico de Miranda de Ebro
www. ctme.es
lpereda@ctme.es

EPD OWNER

Viuda de Sainz, S.A.
Polígono El Campillo 19
48500 Abanto-Zierbena (Bizkaia)
viudadesainz@viudadesainz.com
+0034 94 636 17 22

EPD AUTHOR

IDNÓVAM
Innovación y desarrollo para el ambiente
Ferranz 56, Bajo
28008 Madrid
info@idnovam.com

CO-AUTHOR & BIM INTEGRATION

INGREEN INNOVACIÓN
Paseo Uribitarte, 6
48020 Bilbao
admin@ingreen.es

Viuda de Sainz

www. viudadesainz.com